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Mellanox FlexBoot

User Manual

Rev 2.1

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Document Revision History

Table 1: Document Revision History

Revision	Date	Description

2.1	February 09, 2015	• Updated the note in section Running the DHCP Server
		• Removed sections:
		  • iSCSI General Parameters
		  • DHCP Parameters
		  • DHCP IP
		  • DHCP Parameters
		  • IP Version

2.0	January 15, 2015	Initial release of the restructured new User Manual.

1 Mellanox FlexBoot (PXE)

1.1 Overview

Mellanox FlexBoot is a multiprotocol remote boot technology. FlexBoot supports remote Boot over InfiniBand (BoIB) and over Ethernet.

Using Mellanox Virtual Protocol Interconnect (VPI) technologies available in ConnectX® adapters, FlexBoot gives IT Managers' the choice to boot from a remote storage target (iSCSI target) or a LAN target (Ethernet Remote Boot Server) using a single ROM image on Mellanox ConnectX products.

FlexBoot is based on the open source project iPXE available at http://www.ipxe.org.

FlexBoot first initializes the adapter device, senses the port protocol – Ethernet or InfiniBand, and brings up the port. Then it connects to a DHCP server to obtain its assigned IP address and network parameters, and also to obtain the source location of the kernel/OS to boot from. The DHCP server instructs FlexBoot to access the kernel/OS through a TFTP server, an iSCSI target, or some other service.

For an InfiniBand port, Mellanox FlexBoot implements a network driver with IP over IB acting as the transport layer. IP over IB is part of the Mellanox OFED for Linux software package (see www.mellanox.com → Products → InfiniBand/VPI Drivers → FlexBoot).

1.2 Supported Mellanox Adapter Devices and Firmware

The package supports the following HCA and firmware versions:

Table 2: Supported Mellanox Adapter Devices and Firmware

HCAs	Firmware Version
ConnectX®-2	2.9.1000
ConnectX®-3	2.33.5000
ConnectX®-3 Pro	2.33.5000
Connect-IB®	10.10.5000

1.3 FlexBoot Package

The FlexBoot package is provided as a tarball (.tgz extension). Uncompress it using the command "tar zxf <package file name>". The tarball contains PXE binary files (with the *.mrom extension) for the supported adapter devices. See the release notes file FlexBoot-<flexboot_version>_release_notes.txt for details.

2 Burning the Expansion ROM Image

2.1 Burning the Image on ConnectX® Family Devices

2.1.1 Prerequisites

- Expansion ROM Image

  The expansion ROM images are provided as part of the Mellanox FlexBoot package and are listed in the release notes file `FlexBoot-<flexboot_version>_release_notes.txt`.

- Firmware Burning Tools

  You need to install the Mellanox Firmware Tools (MFT) package (version 3.7.0 or later) in order to burn the PXE ROM image. To download MFT, see Firmware Tools under www.mellanox.com > Products > InfiniBand/VPI Drivers > Firmware Tools.

2.1.2 Image Burning Procedure

➢ ***To burn the composite image, perform the following steps:***

1. Obtain the MST device name. Run:

   ```
   # mst start
   ```

   The device name will be of the form: **`mt<dev_id>_pci{_cr0|conf0}`**.[1]

2. Create and burn the composite image. Run:

   ```
   flint -dev <mst device name> brom <expansion ROM image>
   ```

   Example on Linux:

   ```
   flint -d /dev/mst/mt4103_pci_cr0 brom FlexBoot-3.4.442_4103.mrom
   ```

   Example on Windows:

   ```
   flint -dev mt26428_pci_cr0 brom FlexBoot-3.4.442_4103.mrom
   ```

2.2 Removing the Expansion ROM Image

- Remove the expansion ROM image. Run:

  ```
  flint -dev <mst device name> drom
  ```

NOTE: When removing the expansion ROM image, you also remove Flexboot from the boot device list.

[1] Depending on the OS, the device name may be superseded with a prefix.

3 Preparing the DHCP Server in Linux

When the boot session starts, the PXE firmware attempts to bring up an adapter network link (port). If it succeeds to bring up a connected link, the PXE firmware communicates with the DHCP server. The DHCP server assigns an IP address to the PXE client and provides it with the location of the boot program.

3.1 Case I: InfiniBand Ports

3.1.1 Installing DHCP

FlexBoot requires that the DHCP server runs on a machine which supports IP over IB.

1. Prior to installing DHCP, make sure that Mellanox OFED for Linux is already installed on your DHCP server – see www.mellanox.com.
2. ISC DHCP of versions above 3.1.3 have native support for IPoIB clients. If using DHCP v3.1.3, the provided patch must be deployed. Newer versions do not require patching.
3. To download and install other supported DHCP server versions, please download

   Mellanox OFED from www.mellanox.com → Products → InfiniBand/VPI Drivers → Linux SW/Drivers and refer to docs/dhcp/README.

Standard DHCP fields holding MAC addresses are not large enough to contain an IPoIB hardware address. To overcome this problem, DHCP over InfiniBand messages convey a client identifier field (in DHCP option 61) used to identify the DHCP session. This client identifier field can be used to associate an IP address with a client identifier value, such that the DHCP server will grant the same IP address to any client that conveys this client identifier.

NOTE: In the DHCP discover packets, flexboot sends "hlen" 6 rather than 0.

"chaddr" will be the ethernet mac address rather than zeros.

In the DHCP server, the GUID in the client identifier can still be used to identify clients.

3.1.2 Configuring the DHCP Server

3.1.2.1 For ConnectX Family Devices

When a FlexBoot client boots, it sends the DHCP server various information including its DHCP client identifier. This identifier is used to distinguish between the various DHCP sessions. The value of the client identifier is composed of a prefix — ff:00:00:00:00:00:02:00:00:02:c9:00 — and an 8-byte port GUID (all separated by colons and represented in hexadecimal digits).

3.1.2.2 Extracting the Port GUID – Method I

- ***To obtain the port GUID:***

1. Start mst.

```
host1# mst start
host1# mst status
```

The following MFT commands assume that the Mellanox Firmware Tools (MFT) package has been installed on the client machine.

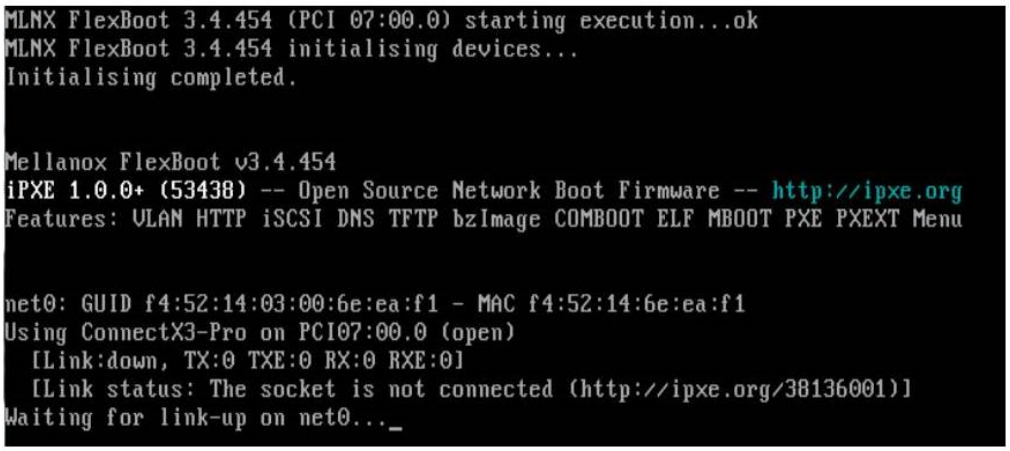
2. Obtain the Port GUID using the device name. The device name will be of the form: /dev/mst/ mt<dev_id>_pci{_cr0|conf0}.

```
flint -d <MST_DEVICE_NAME> q
```

Assuming that FlexBoot is connected via Port 1, then the Port GUID is 00:02:c9:03:00:00:10:39

3.1.2.3 Extracting the Port GUID – Method II

An alternative method for obtaining the port GUID involves booting the client machine via Flex- Boot. This requires having a Subnet Manager running on one of the machines in the InfiniBand subnet. The 8 bytes can be captured from the boot session as shown in the figure below.



3.1.2.4 Placing Client Identifiers in /etc/dhcpd.conf

The following is an excerpt of a `/etc/dhcpd.conf` example file showing the format of representing a client machine for the DHCP server

```
host host1 {
next-server 11.4.3.7; filename "pxelinux.0"; fixed-address 11.4.3.130;
option dhcp-client-identifier =
ff:00:00:00:00:00:02:00:00:02:c9:00:00:02:c9:03:00:0c:78:11;
}
```

3.1.3 Running the DHCP Server

NOTE: This section is applicable only when the Initiator's IP address is empty.

In order for the DHCP server to provide configuration records for clients, an appropriate configuration file needs to be created. By default, the DHCP server looks for a configuration file called `dhcpd.conf` under `/etc`. You can either edit this file or create a new one and provide its full path to the DHCP server using the -cf flag. See a file example at `docs/dhcpd.conf` of this package.

The DHCP server must run on a machine which has loaded the IPoIB module.

To run the DHCP server from the command line, enter:

```
dhcpd <IB network interface name> -d
```

Example:

```
host1# dhcpd ib0 -d
```

3.1.4 Adding Device Driver Support in Linux Kernels/Initrd

NOTE: A DHCP client can be used if you need to prepare a diskless machine with an IB driver. See Step 11 under Example: Adding an IB Driver to initrd (Linux).

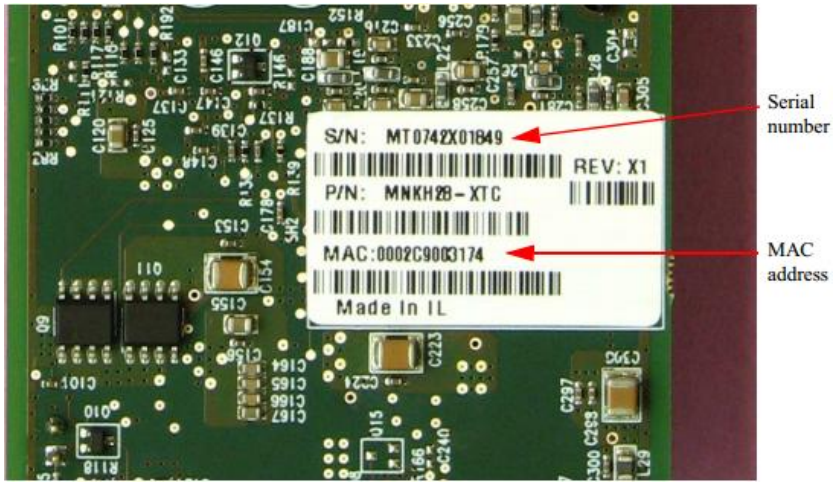
3.2 Case II: Ethernet Ports

When a FlexBoot client boots, it sends the DHCP server various information, including its DHCP hardware Ethernet address (MAC). The MAC address is 6 bytes long, and it is used to distinguish between the various DHCP sessions.

3.2.1 Extracting the MAC Address – Method I

All Mellanox Ethernet NICs have a label on the printed side of the adapter card that has the card serial number and the card MAC address.

Figure 1: NIC Label



3.2.2 Extracting the MAC Address – Method II

The six bytes of MAC address can be captured from the display upon the boot of the ConnectX device session as shown in the figure below.

3.2.3 Extracting the MAC Address – Method III

- ***In case the previous methods fail to work, perform the following as a last resort:***

1. Start mst.

```
host1# mst start
host1# mst status
```

The following MFT commands assume that the Mellanox Firmware Tools (MFT) package has been installed on the client machine.

2. Obtain the MAC using the device name. The device name will be of the form: /dev/mst/mt<dev_id>_pci{_cr0|conf0}.

```
flint -d <MST_DEVICE_NAME> q
```

Assuming that FlexBoot is connected via Port 1, then the MAC address is 00:02:c9:0c:7c:11.

3.2.4 Placing MAC Addresses in /etc/dhcpd.conf

The following is an excerpt of a `/etc/dhcpd.conf` example file showing the format of representing a client machine for the DHCP server running on a Linux machine.

```
host host1 {
next-server 11.4.3.7; filename "pxelinux.0"; fixed-address 11.4.3.130;
hardware ethernet 00:02:c9:0c:78:12;
}
```

4 Subnet Manager – OpenSM

NOTE: This section applies to ports configured as InfiniBand only.

FlexBoot requires a Subnet Manager to be running on one of the machines in the IB network. OpenSM is part of the *Mellanox OFED for Linux* software package and can be used to accomplish this. Note that OpenSM may be run on the same host running the DHCP server but it is not mandatory.

For large InfiniBand clusters (> 100 nodes), it is recommended to use OpenSM caching. For further information, please refer to the Mellanox OFED User Manual.

5 BIOS Configuration

The expansion ROM image presents itself to the BIOS as a boot device. As a result, the BIOS will add to the list of boot devices “MLNX FlexBoot <ver>” for a ConnectX family device. The priority of this list can be modified through BIOS setup.

6 Flexboot User Interface

6.1 Skipping FlexBoot, FlexBoot User Interface and FlexBoot Port

You can skip FlexBoot in any of the given options below:

- Following system POST, when a FlexBoot advertisement banner and configuration prompt is displayed, Press any key other than CTRL-B.
- When FlexBoot execution starts (as depicted in the "Initializing Devices" screen output), a UI prompt for escaping shortly follows.
- After the BIOS called BEV_ENTRY: Press ESC when prompted (2-3 seconds)
- Skip a specific port when booting starts: Press CTRL-C

6.2 Invoking the User Interface

Shortly after completion of the POST (Power-On-Self-Test sequence of the computer), the user will be prompted to press CTRL-B to invoke Mellanox FlexBoot User Interface. The user has few seconds to press CTRL-B before the message disappears.

```
Mellanox FlexBoot v3.4.435
iPXE (http://ipxe.org) 05:00.0 D300 PCI3.00 PnP PMM+002676C0+002816C0 D300
Press Ctrl-B to configure MLNX FlexBoot 3.4.435 (PCI 05:00.0)...
```

Alternatively, you may skip invoking User Interface right after POST and invoke it instead right after FlexBoot *starts* booting.

6.2.1 Browsing the User Interface Menu

To browse the menu, use the following keys:

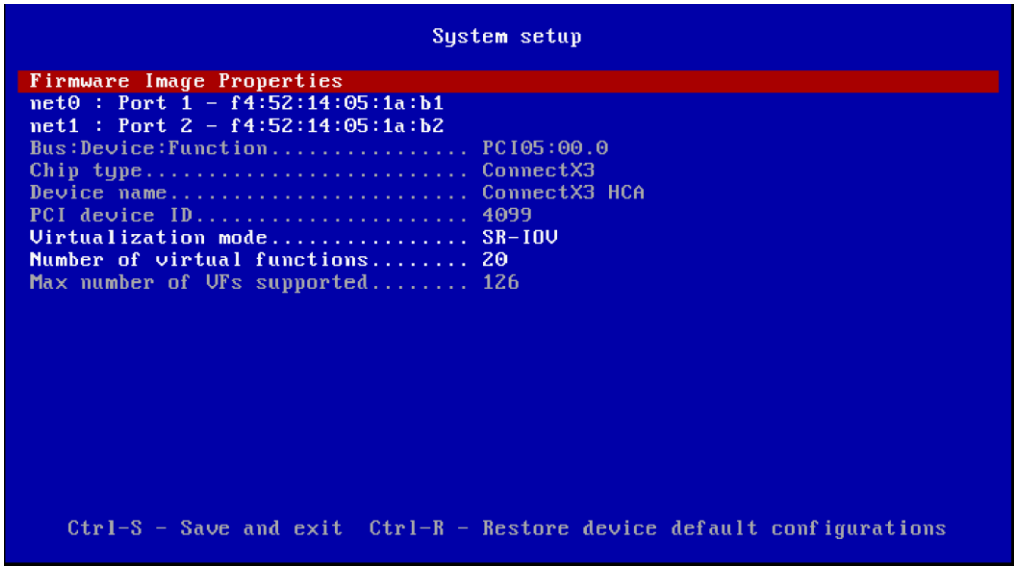
Table 3: PXE Browsing Keys

Key	Operation
Arrows ↑↓	Browse options (Highlighted option is current)
Enter	On forms – to enter menu On configurable settings – edit configuration
Esc	Exit current menu

6.2.2 Accessing FlexBoot Sub Menus

To enter the required menu, press Enter while the option is highlighted.

Figure 2: Main Menu Window



For further information on FlexBoot varies menus, and the configuration options they provide, please refer to section System Settings Configuration Options and its subsections.

6.3 Configuring System Settings

NOTE: It is possible to save the changes made and exit the menu at any given time by pressing Ctrl+S.

6.3.1 Editing the Parameters using Free Text

When a configurable setting is highlighted, the instructions to edit it will be shown on screen. If the setting is configurable via input, the description will show the input restrictions.

➢ **To change the configuration:**

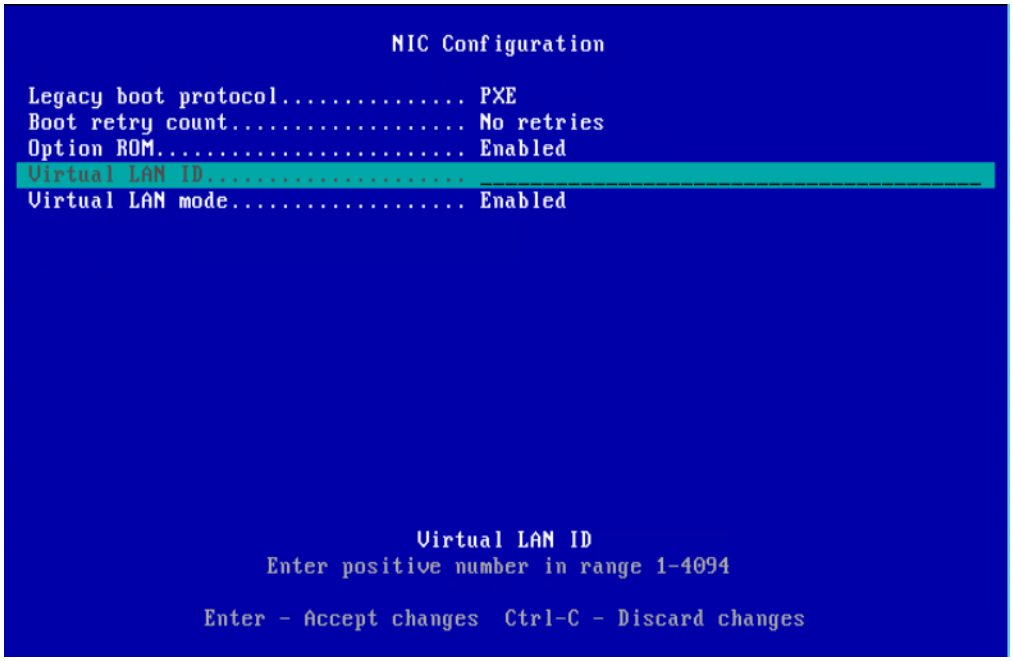
3. Press Enter or start typing while the setting is highlighted.
4. [Optional] To discard the input while editing, press Ctrl+C.
5. Press Enter and wait to verify the new value is accepted and shown.

In case the value entered is invalid, an alert will be shown and the new value won't be accepted.

NOTE: Although numeric values are shown in decimal base, it is possible to insert values in different bases:

- For hexadecimal base type "0x" before the number
- For octal base type "0" before the number
- For decimal base type the number as is

Figure 3: Free Text Editing Example



6.3.2 Editing the Parameters using Set Values

When a configurable setting is highlighted, the instructions to edit it will be shown on screen. If the setting is configurable with built-in options, the description will be "Select to change value".

➢ **To change the configuration:**

1. Press Enter while setting is highlighted.
2. Keep pressing Enter to choose the desired value

6.3.3 Deleting Configurable Settings

Configurable settings can be deleted. Value will only be deleted from the current configuration and not from the flash. If the configuration has a default value, it will be set when deleting the current value.

➢ **To delete a configurable setting:**

1. Press Ctrl+D while setting is highlighted.

6.3.4 Restoring Default Configurations

All configurations can be restored to the default values set in the device. All configurable values will be modified to "default" or "deleted" if there is no default value in the device.

➢ ***To restore defaults per port:***

- Press Ctrl+R on the main menu of the port only when applicable

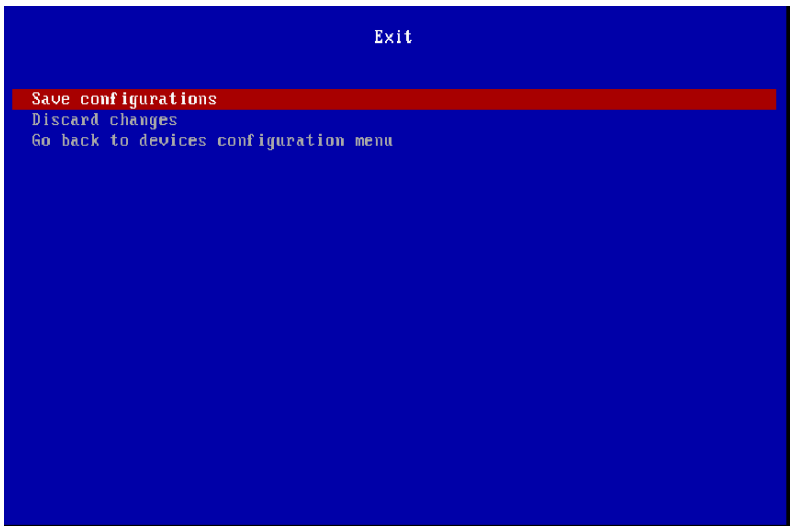
➢ ***To restore defaults per device:***

- Press Ctrl+R on "System setup" menu when applicable

6.4 Exiting FlexBoot User Interface

To exit FlexBoot User Interface press ESC from the System Setup menu.

Figure 4: Exit Menu



7 System Settings Configuration Options

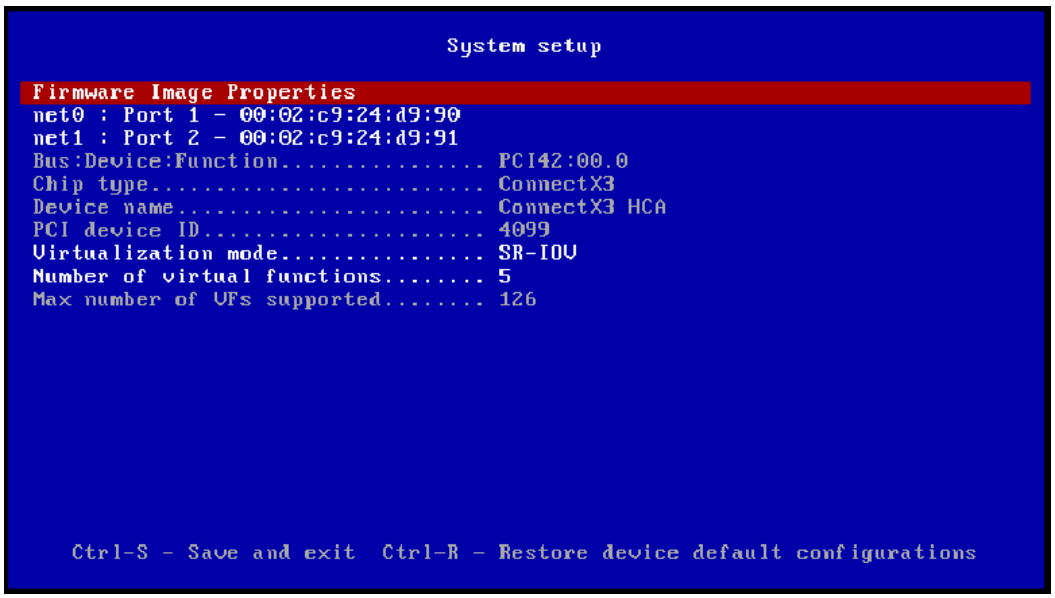
Below are listed the attributes shown in varies FlexBoot User Interface menus.

7.1 System Setup

In the following menu, you can set the following options:

- Bus:Device:Function
- Chip Type
- Device Name
- PCI Device ID
- Virtualization Mode
- Number of Virtual Functions
- Max Number of VFs Supported

Figure 5: System Setup Menu



7.1.1 Bus:Device:Function

Location:	System setup
Description:	Specifies the BIOS assigned PCI Bus:Device:Function identifier of the card
Configurable:	No

7.1.2 Chip Type

Location:	System setup
Description:	Specifies the chip type
Configurable:	No

7.1.3 Device Name

Location:	System setup
Description:	The device's product name
Configurable:	No

7.1.4 PCI Device ID

Location:	System setup
Description:	The PCI Device ID of the controller
Configurable:	No

7.1.5 Virtualization Mode

Location:	System setup
Description:	Specifies the type of virtualization used by the controller on all ports. Only valid for adapters that support SR-IOV virtualization mode.
Configurable:	Yes – built-in options
Persistency:	Persistent through AC cycle
Reboot required:	Yes – reboot is needed in order for this change to apply
Available options:	1. None 2. SR-IOV

7.1.6 Number of Virtual Functions

Location:	System setup
Description:	The number of virtual functions advertised and usable by the driver
Configurable:	Yes – via input – If virtualization mode is SR-IOV
Persistency:	Persistent through AC cycle
Reboot required:	Yes – reboot is needed in order for this change to apply
Value restrictions:	Minimum integer value is 0. Maximum integer value is the value displayed in attribute "Max number of VFs supported".

7.1.7 Max Number of VFs Supported

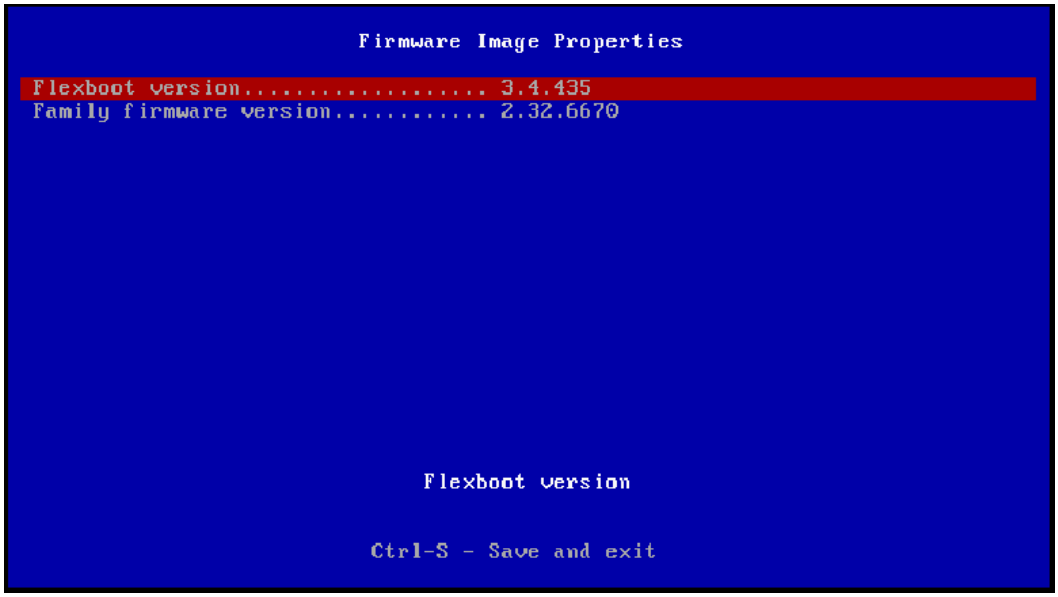
Location:	System setup
Description:	The maximum number of virtual functions supported on the port.
Configurable:	No

7.2 Firmware Image Properties

In the following menu, you can set the following options:

- Flexboot Version
- Family Firmware Version

Figure 6: Firmware Image Properties Menu



7.2.1 Flexboot Version

Location:	System setup /Firmware Image Properties
Description:	Flexboot driver version information
Configurable:	No

7.2.2 Family Firmware Version

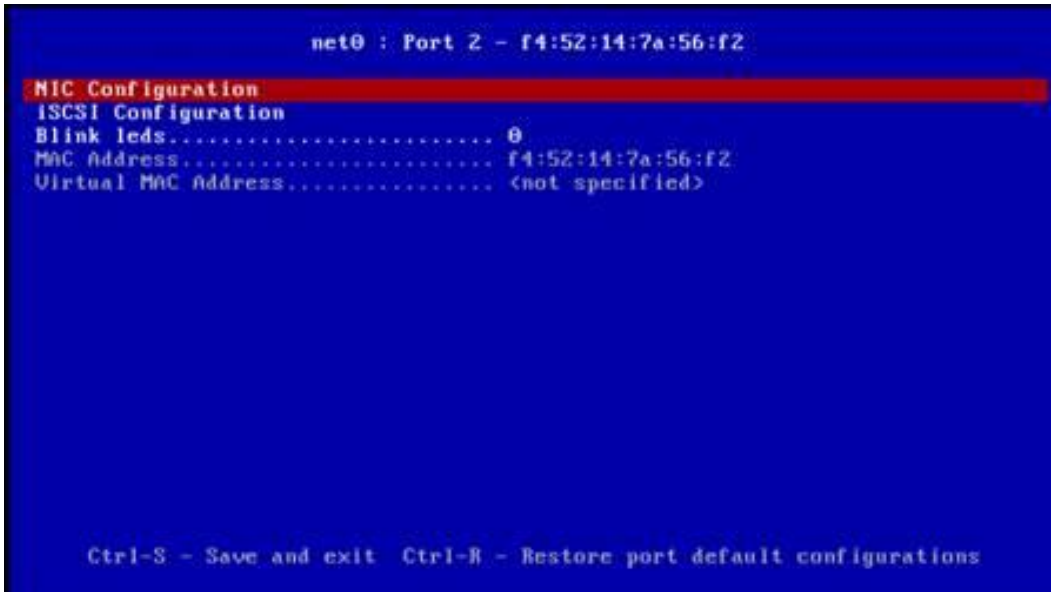
Location:	System setup /Firmware Image Properties
Description:	Device's firmware version information.
Configurable:	No

7.3 Main Configuration

In the following menu, you can set the following options:

- Blink LEDs
- MAC Address
- Virtual MAC Address

Figure 7: Main Configuration



7.3.1 Blink LEDs

NOTE: This configuration is applied when presssing Enter, so it may take longer time to save than other configurations.

Location:	System setup/Port main configurations
Description:	Specifies the number of seconds the LEDs on physical network port should blink to assist with port identification. Only valid for adapters with blink LEDs.
Configurable:	Yes – via input
Persistency:	Valid only for current cycle
Effects:	Blink LEDs duration value of the port will be as set in the current cycle
Value restrictions:	The minimum integer value is 0 and the maximum is 15.

7.3.2 MAC Address

Location:	System setup/Port main configurations
Description:	Permanent MAC address assigned during manufacturing
Configurable:	No

7.3.3 Virtual MAC Address

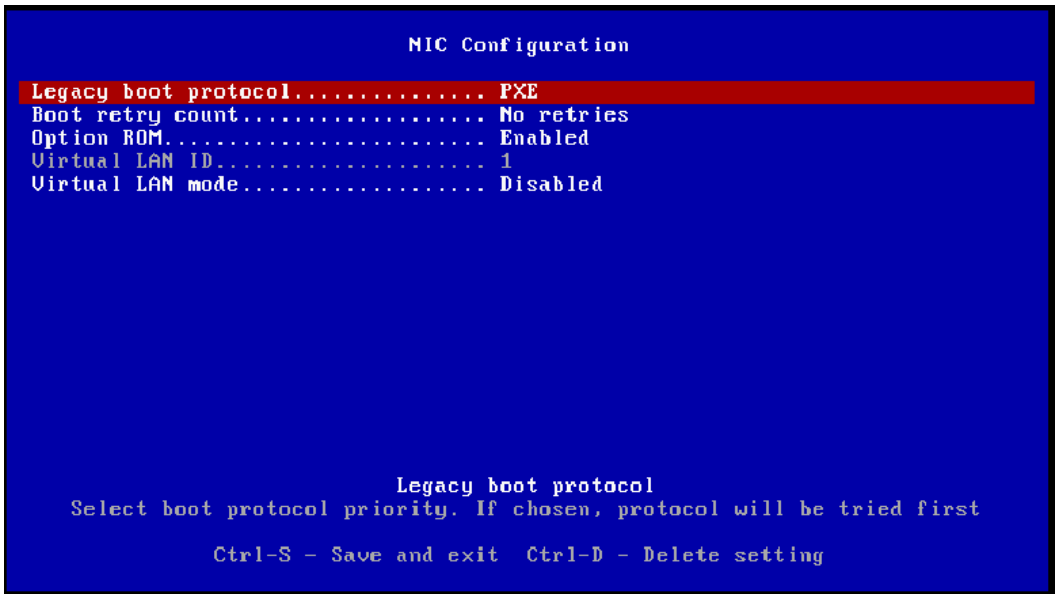
Location:	System setup/Port main configurations
Description:	The port's virtual MAC address
Configurable:	No

7.4 NIC Configuration

In the following menu, you can set the following options:

- Legacy Boot Protocol
- Boot Retry Count
- Wake on LAN
- Option ROM
- Virtual LAN ID
- Virtual LAN Mode

Figure 8: NIC Configuration



7.4.1 Legacy Boot Protocol

Location:	System setup/Port main configurations/NIC Configuration
Description:	Use a non-UEFI network boot protocol. The chosen protocol is tried first; if boot fails the other protocol will be used.
Configurable:	Yes – built-in options
Persistency:	Persistent through AC cycle
Available options:	1. None – no PXE boot, no iSCSI boot 2. PXE – PXE first and if failed try iSCSI

	3. iSCSI – iSCSI first and if failed try PXE

7.4.2 Boot Retry Count

Location:	System setup/Port main configurations/NIC Configuration
Description:	The number of retries to attempt in case of a boot failure.
Configurable:	Yes – built-in options
Persistency:	Persistent through AC cycle
Available options:	0. No retries 1. Retry 2. Retries 3. Retries 4. Retries 5. Retries 6. Retries 7. Indefinite Retries

7.4.3 Wake on LAN

Location:	System setup/Port main configurations/NIC Configuration
Description:	Status of Wake on LAN feature. When set, it enables the server to be powered using an in-band magic packet. Only valid for adapters that support Wake on LAN.
Configurable:	Yes – built-in options
Persistency:	Persistent through AC cycle
Available options:	1. Enabled 2. Disabled

7.4.4 Option ROM

Location:	System setup/Port main configurations/NIC Configuration
Description:	Controls the enablement of legacy Boot Protocols in the Option ROM. If disabled, no legacy boot protocol is chosen. When set, the boot protocol will be chosen by "Boot legacy protocol" attribute.
Configurable:	Yes – built-in options
Persistency:	Persistent through AC cycle
Reboot required:	Yes – reboot is needed in order for this change to apply
Available options:	1. Enabled 2. Disabled

7.4.5 Virtual LAN ID

Location:	System setup/Port main configurations/NIC Configuration
Description:	Uses the VLAN tag with the selected boot protocol.

Configurable:	Yes – via input – If virtual LAN mode is enabled
Value restrictions:	The minimum integer value is 1 and Maximum integer value is 4094.

7.4.6 Virtual LAN Mode

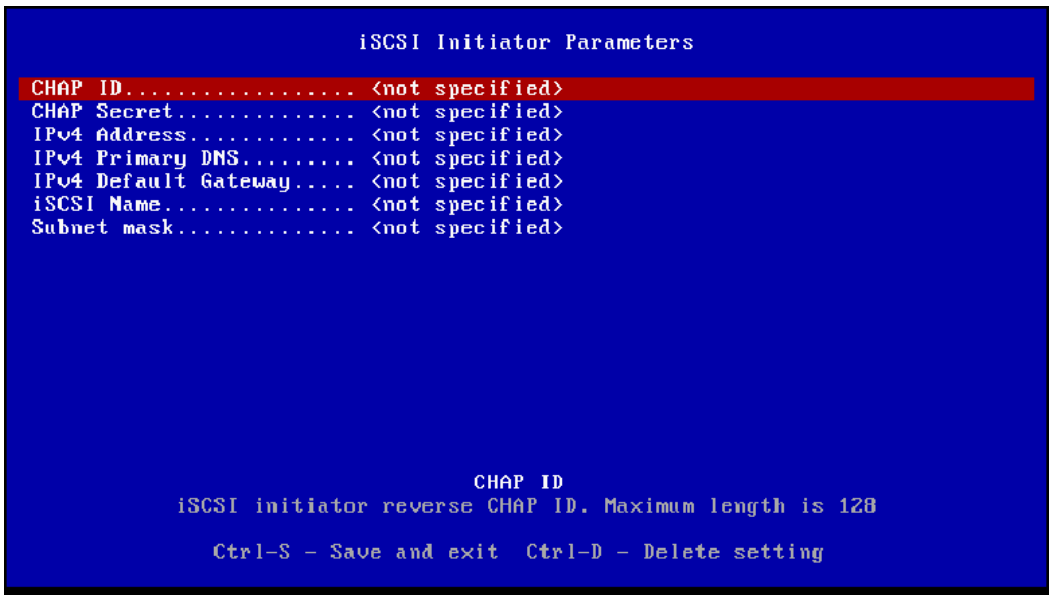
Location:	System setup/Port main configurations/NIC Configuration
Description:	Enable/Disable VLAN tagging on the selected boot protocol.
Configurable:	Yes – built-in options
Persistency:	Persistent through AC cycle
Available options:	1. Enabled 2. Disabled

7.5 iSCSI Initiator Parameters

In the following menu, you can set the following options:

- CHAP ID
- CHAP Secret
- IPv4 Address
- IPv4 Primary DNS
- IPv4 Default Gateway
- iSCSI Name
- Subnet Mask

Figure 9: iSCSI Initiator Parameters



7.5.1 CHAP ID

Location:	System setup/Port main configurations/iSCSI Configuration/iSCSI Initiator Parameters
Description:	The iSCSI initiator Challenge-Handshake Authentication Protocol (CHAP) ID
Configurable:	Yes – via input
Persistency:	Persistent through AC cycle
Effects:	If the legacy boot protocol is iSCSI – This will be the username used for the iSCSI initiator Challenge-Handshake Authentication Protocol.
Value restrictions:	Maximum string length is 128.

7.5.2 CHAP Secret

Location:	System setup/Port main configurations/iSCSI Configuration/iSCSI Initiator Parameters
Description:	The iSCSI initiator Challenge-Handshake Authentication Protocol (CHAP) secret (password).
Configurable:	Yes – via input
Persistency:	Persistent through AC cycle
Effects:	If the legacy boot protocol is iSCSI – This will be the password used for the iSCSI initiator Challenge-Handshake Authentication Protocol.
Value restrictions:	String length should be 0 or 12 to 16

7.5.3 IPv4 Address

Location:	System setup/Port main configurations/iSCSI Configuration/iSCSI Initiator Parameters
Description:	iSCSI initiator's IPv4 address
Configurable:	Yes – via input
Persistency:	Persistent through AC cycle
Effects:	If the legacy boot protocol is iSCSI – This will be set as the IP address of the initiator.
Value restrictions:	Should be in IPv4 format

7.5.4 IPv4 Primary DNS

Location:	System setup/Port main configurations/iSCSI Configuration/iSCSI Initiator Parameters
Description:	The iSCSI initiator Primary DNS IP Address.
Configurable:	Yes – via input
Persistency:	Persistent through AC cycle
Effects:	If the legacy boot protocol is iSCSI – This will be set as the DNS for the IP address of the initiator.

Value restrictions:	Should be in IPv4 format

7.5.5 IPv4 Default Gateway

Location:	System setup/Port main configurations/iSCSI Configuration/iSCSI Initiator Parameters
Description:	The iSCSI initiator default Gateway IP address.
Configurable:	Yes – via input
Persistency:	Persistent through AC cycle
Effects:	If the legacy boot protocol is iSCSI – This will be set as the default gateway IP address of the initiator.
Value restrictions:	Should be in IPv4 format

7.5.6 iSCSI Name

Location:	System setup/Port main configurations/iSCSI Configuration/iSCSI Initiator Parameters
Description:	The initiator's iSCSI Qualified Name (IQN).
Configurable:	Yes – via input
Persistency:	Persistent through AC cycle
Effects:	If the legacy boot protocol is iSCSI – This will be set as the iSCSI Qualified Name of the initiator.
Value restrictions:	Maximum string length is 223

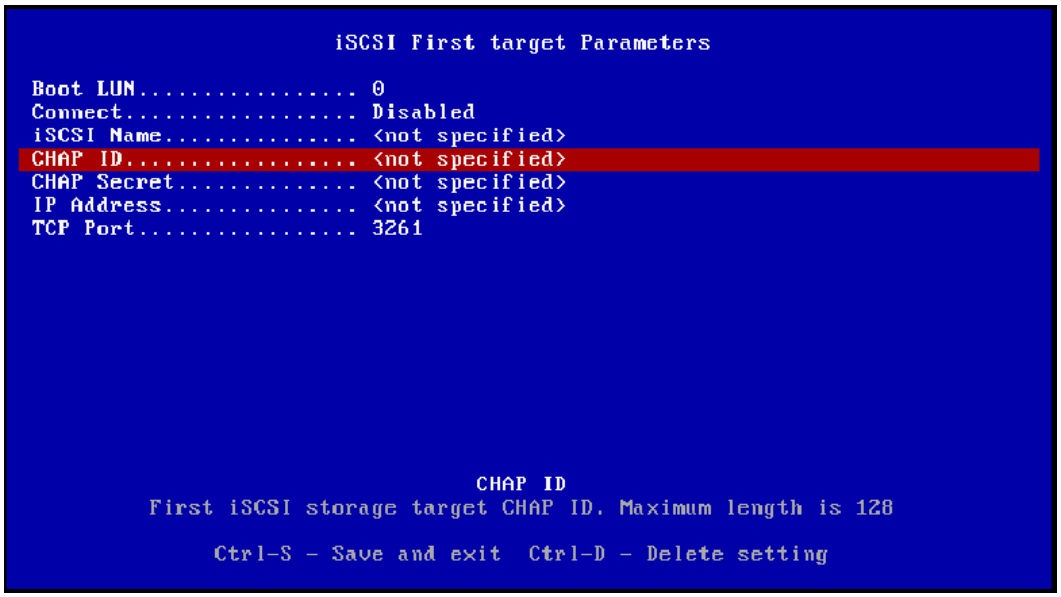
7.5.7 Subnet Mask

Location:	System setup/Port main configurations/iSCSI Configuration/iSCSI Initiator Parameters
Description:	The iSCSI initiator Subnet Mask for an IPv4 initiator configuration.
Configurable:	Yes – via input
Persistency:	Persistent through AC cycle
Effects:	If the legacy boot protocol is iSCSI – This will be set as the subnet mask for the IP address of the initiator.
Value restrictions:	Should be in IPv4 format

7.6 iSCSI First Target Parameters

In the following menu, you can set the following options:

- Boot LUN
- Connect
- iSCSI Name
- CHAP ID
- CHAP Secret
- IP Address
- TCP Port



7.6.1 Boot LUN

Location:	System setup/Port main configurations/iSCSI Configuration/iSCSI First target Parameters
Description:	The boot Logical Unit Number (LUN) on the first iSCSI storage target.
Configurable:	Yes – via input
Persistency:	Persistent through AC cycle
Effects:	If the legacy boot protocol is iSCSI and Connect is enabled – This will be the boot LUN in the root path for the first target.
Value restrictions:	The minimum integer value is 0 and the maximum is 18446744073709551615.

7.6.2 Connect

Location:	System setup/Port main configurations/iSCSI Configuration/iSCSI First target Parameters
Description:	Enable/Disable connecting to the first iSCSI target. This will be ignored if both DHCP IP and DHCP Parameters are enabled in iSCSI general parameters.
Configurable:	Yes – built-in options
Persistency:	Persistent through AC cycle
Available options:	1. Enabled 2. Disabled

7.6.3 iSCSI Name

Location:	System setup/Port main configurations/iSCSI Configuration/iSCSI First target Parameters
Description:	The iSCSI Qualified Name (IQN) of the first target
Configurable:	Yes – via input
Persistency:	Persistent through AC cycle
Effects:	If the legacy boot protocol is iSCSI and Connect is enabled – This will be the iSCSI Qualified name in the root path for the first target.
Value restrictions:	Maximum string length is 223

7.6.4 CHAP ID

Location:	System setup/Port main configurations/iSCSI Configuration/iSCSI First target Parameters
Description:	The first iSCSI storage target Challenge-Handshake Authentication Protocol (CHAP) ID.
Configurable:	Yes – via input
Persistency:	Persistent through AC cycle
Effects:	If the legacy boot protocol is iSCSI and Connect is enabled – This will be the reverse username used for the first target Challenge-Handshake Authentication Protocol.
Value restrictions:	Maximum string length is 128.

7.6.5 CHAP Secret

Location:	System setup/Port main configurations/iSCSI Configuration/iSCSI First target Parameters
Description:	The Challenge-Handshake Authentication Protocol secret (CHAP password) of the first iSCSI storage target.
Configurable:	Yes – via input
Persistency:	Persistent through AC cycle

Effects:	If the legacy boot protocol is iSCSI and Connect is enabled – This will be the reverse password used for the first target Challenge-Handshake Authentication Protocol.
Value restrictions:	String length should be 0 or 12 to 16

7.6.6 IP Address

Location:	System setup/Port main configurations/iSCSI Configuration/iSCSI First target Parameters
Description:	The IP address of the first iSCSI target
Configurable:	Yes – via input
Persistency:	Persistent through AC cycle
Effects:	If the legacy boot protocol is iSCSI and Connect is enabled – This will be the IP address in the root path for the first target.
Value restrictions:	Should be in IPv4 format

7.6.7 TCP Port

Location:	System setup/Port main configurations/iSCSI Configuration/iSCSI First target Parameters
Description:	TCP Port number of first iSCSI target
Configurable:	Yes – via input
Persistency:	Persistent through AC cycle
Effects:	If the legacy boot protocol is iSCSI and Connect is enabled – This will be the TCP Port in the root path for the first target.
Value restrictions:	The minimum integer value is 1, and the maximum is 65535.

8 How to Boot

8.1 PXE Boot

8.1.1 Prerequisites

- Make sure that your client is connected physically and logically to the server(s)
- The FlexBoot image is already programmed on the adapter card
- For InfiniBand ports only: Start the Subnet Manager
- Configure and start the DHCP server
- Configure and start at least one of the services such as: iSCSI

8.1.2 Starting Boot

Boot the client machine and enter BIOS setup to configure “MLNX FlexBoot” to be the first on the boot device priority list.

NOTE: On dual-port network adapters, the client first attempts to boot from Port 1. If this fails, it switches to boot from Port 2. Note also that the driver waits up to 10 seconds for port come up and up to 90 seconds to assign an IP from the DHCP server.

If MLNX FlexBoot was selected through BIOS setup, the client will boot from FlexBoot. The client will display FlexBoot attributes, sense the port protocol – Ethernet or InfiniBand. The port sensing occurs only when the port is connected to a QSFP connector. In case of an InfiniBand port, the client will also wait for port configuration by the Subnet Manager. If auto-sensing proto- col fails, the port will be configured as an InfiniBand port.

After configuring the IB/ETH port, the client attempts to connect to the DHCP server to obtain an IP address and the source location of the kernel/OS to boot from.

For ConnectX (InfiniBand):

```
Mellanox FlexBoot v3.4.400
iPXE 1.0.0+ (9ae6) -- Open Source Network Boot Firmware -- http://ipxe.org
Features: HTTP iSCSI DNS TFTP VLAN bzImage COMBOOT ELF MBOOT PXE PXEXT Menu

net0: GUID 00:02:c9:03:00:b7:10:a0 - MAC 02:02:c9:b7:10:a0
Using ConnectIB on PCI00:05.0 (open)
  [Link:down, TX:0 TXE:0 RX:0 RXE:0]
  [Link status: The socket is not connected (http://ipxe.org/38136001)]
Waiting for link-up on net0..... ok
Configuring (net0 02:02:c9:b7:10:a0)..... ok
net0: 31.134.38.52/255.255.0.0
Next server: 31.134.38.7
Filename: pxelinux.0
Root path: /var/lib/tftpboot
tftp://31.134.38.7/pxelinux.0... ok
```

Next, FlexBoot attempts to boot as directed by the DHCP server.

8.1.3 How to Boot to ESXi

For instructions on booting to ESXi, refer to the ESXi Installation Guide on VMWare site: http://pubs.vmware.com/vsphere-55/index.jsp#com.vmware.vsphere.upgrade.doc/GUID-B9DB94CA-4857-458B-B6F1-6A688726AED0.html

8.1.4 How to Boot Using HTTP Script

After performing basic HTTP configuration, add the following lines to the dhcp server configuration file:

```
host uefi24-1 {
hardware ethernet F4:52:14:7A:56:F1 ;
fixed-address 14.7.6.24;
filename "pxe_script_linux";
option vendor-class-identifier "PXEClient";
}

“pxe_script_linux” file:
#!ipxe
dhcp net0
kernel -n vmlinuz http://14.7.6.30/RHEL6.4-x86_64-DVD1/images/pxeboot/vmlinuz
initrd http://14.7.6.30/RHEL6.4-x86_64-DVD1/images/pxeboot/initrd.img
boot
```

8.2 iSCSI

Mellanox FlexBoot enables an iSCSI-boot of an OS located on a remote iSCSI target. It has a built-in iSCSI initiator which can connect to the remote iSCSI target and load from it the kernel and initrd. There are two instances of connection to the remote iSCSI target: the first is for get- ting the kernel and initrd via FlexBoot, and the second is for loading other parts of the OS via initrd.

If you choose to continue loading the OS (after boot) through the HCA device driver, please verify that the initrd image includes the HCA driver as described in Section 1.2.

NOTE: To boot via iSCSI, Flexboot must be selected from the BIOS boot menu (it will be shown as a BEV entry). Do not look for the entry in the BVC table.

8.2.1 Configuring an iSCSI Target in Linux Environment

8.2.1.1 Prerequisites

- Make sure that an iSCSI Target is installed on your server side.

  You can download and install an iSCSI Target from the following location:

  http://sourceforge.net/projects/iscsitarget/files/iscsitarget/

- Dedicate a partition on your iSCSI Target on which you will later install the operating system
- Configure your iSCSI Target to work with the partition you dedicated. If, for example, you choose partition /dev/sda5, then edit the iSCSI Target configuration file `/etc/ietd.conf` to include the following line under the iSCSI Target iqn line:

```
Lun 0 Path=/dev/sda5,Type=fileio
```

Example of an iSCSI Target iqn line:

```
Target iqn.2007-08.7.3.4.10:iscsiboot
```

- Start your iSCSI Target.

  Example:

```
host1# /etc/init.d/iscsitarget start
```

8.2.1.2 Configuring the DHCP Server to Boot From an iSCSI Target

Configure DHCP as described in Chapter 3, “Preparing the DHCP Server in Linux”.

Edit your DHCP configuration file (/etc/dhcpd.conf) and add the following lines for the machine(s) you wish to boot from the iSCSI target:

```
Filename "";
option root-path "iscsi:iscsi_target_ip::::iscsi_target_iqn";
```

The following is an example for configuring an IB/ETH device to boot from an iSCSI target:

```
host host1{ filename "";
option root-path "iscsi:iscsi_target_ip::::iscsi_target_iqn";
# For a ConnectX device with ports configured as InfiniBand, comment out# the
follow- ing line
# option dhcp-client-identifier =
ff:00:00:00:00:00:02:00:00:02:c9:00:00:02:c9:03:00:00:10:39;

# For a ConnectX device with ports configured as Ethernet, comment out# the
following line
# hardware ethernet 00:02:c9:00:00:bb;
}
```

Appendix A: Diskless Machines

Mellanox FlexBoot supports booting diskless machines.

NOTE: The following configuration insturctions apply only to operation systems which do not include an inbox driver, and should be skipped in case an OS with an inbox driver is used.

To enable using an IB/ETH driver, the initrd image must include a device driver module and be configured to load that driver. This can be achieved by adding the device driver module into the initrd image and loading it.

The 'initrd' image of some Linux distributions such as SuSE Linux Enterprise Server and Red Hat Enterprise Linux, cannot be edited prior or during the installation process.

If you need to install Linux distributions over Flexboot, please replace your 'initrd'

images with the images found at: www.mellanox.com → Products → InfiniBand/VPI Drivers → FlexBoot (Download Tab).

All OSes which doesn't include inbox driver should do the following.

OSes which include the inbox driver should skip these configurations

A.1 Case I: InfiniBand Ports

The IB driver requires loading the following modules in the specified:

- ib_addr.ko
- ib_core.ko
- ib_mad.ko
- ib_sa.ko
- ib_cm.ko
- ib_uverbs.ko
- ib_ucm.ko
- ib_umad.ko
- iw_cm.ko
- rdma_cm.ko
- rdma_ucm.ko
- mlx4_core.ko
- mlx4_ib.ko
- ib_mthca.ko
- ipoib_helper.ko – this module is *not* required for all OS kernels. Please check the release notes.

- ib_ipoib.ko

A.1.1 Example: Adding an IB Driver to initrd (Linux)

A.1.1.1 Prerequisites

- The FlexBoot image is already programmed on the HCA card
- The DHCP server is installed, configured and connected to the client machine
- An `initrd` file.
- To add an IB driver into initrd, you need to copy the IB modules to the diskless image. Your machine needs to be pre-installed with a Mellanox OFED for Linux ISO image (available for download from www.mellanox.com → Products → InfiniBand/VPI Drivers → Linux SW/ Drivers) that is appropriate for the kernel version the diskless image will run.

The remainder of this section assumes that Mellanox OFED has been installed on your machine.

A.1.1.2 Adding the IB Driver to the initrd File

NOTE: The following procedure modifies critical files used in the boot procedure. It must be executed by users with expertise in the boot process. Improper application of this pro- cedure may prevent the diskless machine from booting.

1. Back up your current `initrd` file.
2. Make a new working directory and change to it.

```
host1$ mkdir /tmp/initrd_ib
host1$ cd /tmp/initrd_ib
```

3. Extract the `initrd`.

```
host1$ gzip -dc <initrd image> | cpio -id
```

The `initrd` files are now located at: `/tmp/initrd_ib`

4. Create a directory for the InfiniBand modules and copy them.

```
host1$ mkdir -p /tmp/initrd_ib/lib/modules/ib
host1$ cd /lib/modules/`uname -r`/updates/kernel/drivers
host1$ cp infiniband/core/ib_addr.ko /tmp/initrd_ib/lib/modules/ib
host1$ cp infiniband/core/ib_core.ko /tmp/initrd_ib/lib/modules/ib
host1$ cp infiniband/core/ib_mad.ko /tmp/initrd_ib/lib/modules/ib
host1$ cp infiniband/core/ib_sa.ko /tmp/initrd_ib/lib/modules/ib
host1$ cp infiniband/core/ib_cm.ko /tmp/initrd_ib/lib/modules/ib
host1$ cp infiniband/core/ib_uverbs.ko /tmp/initrd_ib/lib/modules/ib
host1$ cp infiniband/core/ib_ucm.ko /tmp/initrd_ib/lib/modules/ib
host1$ cp infiniband/core/ib_umad.ko /tmp/initrd_ib/lib/modules/ib
host1$ cp infiniband/core/iw_cm.ko /tmp/initrd_ib/lib/modules/ib
host1$ cp infiniband/core/rdma_cm.ko /tmp/initrd_ib/lib/modules/ib
host1$ cp infiniband/core/rdma_ucm.ko /tmp/initrd_ib/lib/modules/ib
host1$ cp net/mlx4/mlx4_core.ko /tmp/initrd_ib/lib/modules/ib
host1$ cp infiniband/hw/mlx4/mlx4_ib.ko /tmp/initrd_ib/lib/modules/ib
host1$ cp infiniband/hw/mthca/ib_mthca.ko /tmp/initrd_ib/lib/modules/ib
host1$ cp infiniband/ulp/ipoib/ipoib_helper.ko
/tmp/initrd_ib/lib/modules/ib
host1$ cp infiniband/ulp/ipoib/ib_ipoib.ko /tmp/initrd_ib/lib/modules/ib
```

5. Load the IPv6 module. If you do not have it in your `initrd`, add it using the following command.

```
host1$ cp /lib/modules/`uname -r`/kernel/net/ipv6/ipv6.ko
/tmp/initrd_ib/lib/modules
```

6. Load the modules using the `insmod` executable. If you do not have it in your `initrd`, add it using the following command.

```
host1$ cp /sbin/insmod /tmp/initrd_ib/sbin/
```

7. **[Optional]** Give your IB device a static IP address.

```
host1$ cp /sbin/ifconfig /tmp/initrd_ib/sbin
```

8. **[Optional]** Obtain an IP address for the IB device through DHCP. Copy the DHCP client which was compiled specifically to support IB.

   To continue with this step, DHCP client needs to be already installed on the machine you are working with.

   Copy the DHCP client file and all the relevant files as described below.

```
host1# cp <path to DHCP client>/dhclient /tmp/initrd_ib/sbin
host1# cp <path to DHCP client>/dhclient-script /tmp/initrd_ib/sbin
host1# mkdir -p /tmp/initrd_ib/var/state/dhcp
host1# touch /tmp/initrd_ib/var/state/dhcp/dhclient.leases
host1# cp /bin/uname /tmp/initrd_ib/bin
host1# cp /usr/bin/expr /tmp/initrd_ib/bin
host1# cp /sbin/ifconfig /tmp/initrd_ib/bin
host1# cp /bin/hostname /tmp/initrd_ib/bin
```

9. Create a configuration file for the DHCP client and place it under `/tmp/initrd_ib/sbin`.

   Example of the `dclient.conf`

```
# The value indicates a hexadecimal number
# For a ConnectX® device interface "ib0" {send dhcp-client-identifier
ff:00:00:00:00:00:02:00:00:02:c9:00:00:02:c9:03:00:00:10:39;
}
```

10. Add the commands for loading the copied modules into the file init at the point you wish the IB driver to be loaded.

    Please pay attention to the following commands order (for loading modules) as it is critical.

    Loading "`ipoib_helper.ko`" is not required for all OS kernels.

```
echo "loading ipv6"
/sbin/insmod /lib/modules/ipv6.ko echo "loading IB driver"
/sbin/insmod /lib/modules/ib/ib_addr.ko
/sbin/insmod /lib/modules/ib/ib_core.ko
/sbin/insmod /lib/modules/ib/ib_mad.ko
/sbin/insmod /lib/modules/ib/ib_sa.ko
/sbin/insmod /lib/modules/ib/ib_cm.ko
/sbin/insmod /lib/modules/ib/ib_uverbs.ko
/sbin/insmod /lib/modules/ib/ib_ucm.ko
/sbin/insmod /lib/modules/ib/ib_umad.ko
/sbin/insmod /lib/modules/ib/iw_cm.ko
/sbin/insmod /lib/modules/ib/rdma_cm.ko
/sbin/insmod /lib/modules/ib/rdma_ucm.ko
/sbin/insmod /lib/modules/ib/mlx4_core.ko
/sbin/insmod /lib/modules/ib/mlx4_ib.ko
/sbin/insmod /lib/modules/ib/ib_mthca.ko
```

    In case of interoperability issues between iSCSI and Large Receive Offload (LRO), set the "`ib_ipoib.ko lro`" to "`0`" to disable LRO.

```
/sbin/insmod /lib/modules/ib/ib_ipoib.ko lro=0
```

11. Assign an IP address to the IB device. Add either a call to `ifconfig` or to the DHCP client in the `init` file after loading the modules. If you want to use the DHCP client, then you need to add a call to the DHCP client in the `init` file after loading the IB modules.

    For example:

```
/sbin/dhclient -cf /sbin/dhclient.conf ib1
```

12. Save the `init` file.
13. Close `initrd`.

```
host1$ cd /tmp/initrd_ib
host1$ find ./ | cpio -H newc -o > /tmp/new_initrd_ib.img
host1$ gzip /tmp/new_init_ib.img
```

14. Copy the modified `initrd` (including the IB driver) which is located at`/tmp/new_init_ib.img.gz` and rename it properly.

A.2 Case II: Ethernet Ports

The Ethernet driver requires loading the following modules in the specified order – see the exam- ple below:

- mlx4_core.ko
- mlx4_en.ko

A.2.1 Example: Adding an Ethernet Driver to initrd (Linux)

A.2.1.1 Prerequisites

- The FlexBoot image is already programmed on the adapter card.
- The DHCP server is installed, configured and connected to the client machine.
- An `initrd` file.
- To add an Ethernet driver into `initrd`, you need to copy the Ethernet modules to the diskless image. Your machine needs to be pre-installed with a *MLNX_EN Linux Driver* (available for download from www.mellanox.com → Products → Ethernet Drivers) that is appropriate for the kernel version the diskless image will run.

A.2.1.2 Adding the Ethernet Driver to the initrd File

The following procedure modifies critical files used in the boot procedure. It must be executed by users with expertise in the boot process. Improper application of this procedure may prevent the diskless machine from booting.

1. Back up your current `initrd` file.
2. Make a new working directory and change to it.

```
host1$ mkdir /tmp/initrd_en
host1$ cd /tmp/initrd_en
```

3. Extract the `initrd` image.

```
host1$ gzip -dc <initrd image> | cpio -id
```

The initrd files can be located at: /tmp/initrd_en

4. Create a directory for the ConnectX EN modules and copy them.

```
host1$ mkdir -p /tmp/initrd_en/lib/modules/mlnx_en
host1$ cd /lib/modules/`uname -r`/updates/kernel/drivers
host1$ cp net/mlx4/mlx4_core.ko /tmp/initrd_en/lib/modules/mlnx_en
host1$ cp net/mlx4/mlx4_en.ko /tmp/initrd_en/lib/modules/mlnx_en
```

5. Load the modules using the `insmod` executable. If you do not have it in your `initrd`, add it using the following command.

```
host1$ cp /sbin/insmod /tmp/initrd_en/sbin/
```

6. **[Optional]** Give your Ethernet device a static IP address.

```
host1$ cp /sbin/ifconfig /tmp/initrd_en/sbin
```

7. Add the commands for loading the copied modules into the file init at the point you wish the Ethernet driver to be loaded.

   Please pay attention to the following commands order (for loading modules) as it is critical.

```
echo "loading Mellanox ConnectX EN driver"
/sbin/insmod lib/modules/mlnx_en/mlx4_core.ko
/sbin/insmod lib/modules/mlnx_en/mlx4_en.ko
```

8. Assign an IP address to the ConnectX EB network interface.
9. Save the `init` file.
10. Close `initrd`.

```
host1$ cd /tmp/initrd_en
host1$ find ./ | cpio -H newc -o > /tmp/new_initrd_en.img
host1$ gzip /tmp/new_init_en.img
```

11. Copy the modified `initrd` (including the Ethernet driver) which is located at`/tmp/new_init_en.img.gz` and rename it properly.